An Expert System for Dosing Renally Excreted Drugs

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Adverse drug reactions are the most common quality-related preventable events in hospitalized patients. Most hospitals have manual or semi-automated procedures for screening drug orders, yet incorrect over- and underdosing remain a common problem. Drugs excreted via renal mechanisms are especially difficult to dose correctly and may have a higher rate of adverse events.

Patients with abnormal creatinine clearance levels are thought to have even higher rates of adverse drug events, mostly due to inappropriate modification of dosing for impaired renal function. [1,2] Less frequently discussed are patients with improving renal function who may be receiving insufficient dosing, leading to suboptimal therapeutic responses.

A preliminary analysis of drug orders at Barnes Hospital suggested that many inappropriate orders were not being detected by the manual system for screening key drugs with a high potential for adverse reactions, already in place. In addition, the manual system could support screening for only eight drugs, yet many more agents need modification with renal failure.[3] This analysis led to the development of an automated system for drug dose screening called DoseChecker.

DoseChecker is a rule-based expert system which screens inpatient drug orders for renally excreted drugs. Using patient demographics, laboratory values, and dosing information, DoseChecker determines the appropriateness of each order, using rules derived from manufacturer's recommendations and local pharmacy-based quality guidelines.

Dosechecker runs in batch mode at 4AM. DoseChecker excludes certain orders, and analyzes each remaining order. If an order violates existing dosing guidelines for the patient's estimated creatinine clearance, an appropriate recommendation is selected. The final classification of a drug order (with its recommendations, if it was a violation) is recorded in an outcomes-tracking table in the database. Each violation generates a paper report which is printed around 5AM in the Central Pharmacy and is distributed to the satellite pharmacies.

The satellite pharmacists review the paper reports and either agree or disagree with DoseChecker's recommendations. If the pharmacist agrees with the recommendation, the prescribing physician is contacted to approve the dose change. The results of the pharmacist's review and the physician's actions are later entered into a database to evaluate DoseChecker's performance.

DoseChecker's functionality is spread over two components: SQL stored procedures which select drug orders to be evaluated, and the expert system which actually applies the dosing rules. These rules have evolved over time, and continue to do so, as the needs of the user community become better defined.

Since deployment, staff pharmacists have been recording various outcomes for each drug dosing violation report produced by DoseChecker. For each violation, the satellite pharmacists record whether or not, and why, they agreed with DoseChecker. We have used this information to evaluate DoseChecker's effectiveness in a clinical situation.

Since deployment, a number of clinical and non-clinical issues has resulted in a reduced clinical effectiveness. Some of these issues can be addressed by additional technology; others require institutional consensus and cooperation. In 1995, DoseChecker will be implemented at another hospital. It will be interesting to see if similar issues exist at another location.

References

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